

1 WHAT IS CLAIMED IS

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1. An acid-sensitive polymer compound,
comprising:

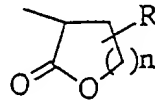
a film-forming polymer;

10 a carboxyl group bonding to a side chain of
said polymer main chain, said carboxyl group having a
protective group; and

15 an additional acidic functional group
bonding to a side chain of said polymer main chain,
said acidic functional group having an acid-cleavable
protective group;

said carboxyl group having, as said
protective group, a lactone structure represented by a
formula

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25 wherein n is an integer of 1 - 4, and R represents any
of a hydrogen atom, an alkyl group, an alkoxy group
or an alkoxy carbonyl group and bonding to an arbitrary
position of said lactone structure excluding a second
position forming an ester bonding.

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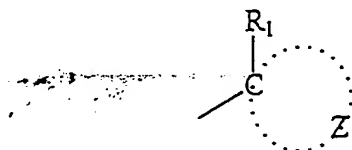
2. An acid-sensitive polymer compound as
claimed in claim 1, wherein said lactone part is
formed of 2-hydroxy- γ (gamma)-butyrolactone.

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1 3. An acid-sensitive polymer compound as
 claimed in claim 1, wherein said acid-sensitive
 polymer includes a monomer unit selected from a group
 consisting of acrylate and methacrylate monomer unit,
 5 a vinylphenol monomer unit and an N-substituted
 maleimide monomer unit.

10 4. An acid-sensitive polymer compound as
 claimed in claim 1, wherein said additional acidic
 functional group includes an additional carboxyl group
 having an acid-cleavable protective group, said acid-
 15 cleavable protective group having a formula of



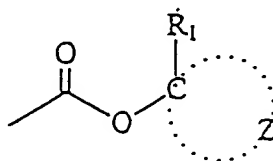
20 wherein R₁ represents an alkyl group having a straight
 chain or a branched chain including 1 - 4 carbon
 atoms, said alkyl group being any of a substituted
 group and an unsubstituted group, and wherein Z₁
 25 represents a plurality of atoms necessary to complete
 an alicyclic hydrocarbon group together with the
 carbon atoms connected to R₁.

30 5. An acid-sensitive polymer compound as
 claimed in claim 1, wherein said additional functional
 group includes a monomer unit having an ester group,
 35 said ester group including a polycyclic alicyclic
 hydrocarbon part that causes a deprotection in
 response to an acid produced by a photoacid generator.

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6. An acid-sensitive polymer compound as claimed in claim 5, wherein said polycyclic alicyclic hydrocarbon part includes an adamantyl group or a norbornyl group.

7. An acid-sensitive polymer compound as claimed in claim 4, wherein said additional carboxyl group having a formula of:

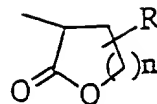


wherein R_1 represents an alkyl group having a straight chain or a branched chain including 1 - 4 carbon atoms, said alkyl group being any of a substituted group and an unsubstituted group, and wherein Z_1 represents a plurality of atoms necessary to complete an alicyclic hydrocarbon group together with the carbon atoms connected to R_1 .

8. A resist composition, comprising:
 an acid-sensitive film-forming polymer insoluble to an alkaline solution; a carboxyl group bonding to a side chain of said polymer's main chain, said carboxyl group having a protective group; and an additional acidic functional group bonding to a side chain of said polymer main chain, said acidic functional group having an acid-cleavable protective group; said carboxyl group having, as said protective group, a lactone structure represented by a formula

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5 wherein n is an integer of 1 - 4, and R represents any of a hydrogen atom, an alkyl group, an alkoxy group or an alkoxy carbonyl group and bonding to an arbitrary position of said lactone structure excluding a second position forming an ester bonding; and

10 a photoacid generator causing a decomposition in response to an absorption of a radiation, said photoacid generator releasing an acid that causes a deprotection of said acid-cleavable protective group in response to said decomposition;

15 said resist composition becoming soluble to said alkaline solution after said acid-cleavable protective group has caused said deprotection.

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9. A resist composition as claimed in claim 8, wherein said lactone part is formed of 2-hydroxy- γ -butyrolactone.

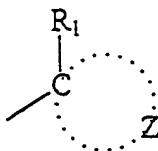
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30 10. A resist composition as claimed in claim 8, wherein said acid-sensitive polymer includes a monomer unit selected from a group consisting of acrylate and methacrylate monomer unit, a vinylphenol monomer unit and an N-substituted maleimide monomer unit.

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1 11. A resist composition as claimed in
claim 8, wherein said additional acidic functional
group includes an additional carboxyl group having an
acid-cleavable protective group, said acid-cleavable
5 protective group having a formula of



10 wherein R₁ represents an alkyl group having a straight
chain or a branched chain including 1 - 4 carbon
atoms, said alkyl group being any of a substituted
group and an unsubstituted group, and wherein Z₁
represents a plurality of atoms necessary to complete
15 an alicyclic hydrocarbon group together with the
carbon atoms connected to R₁.

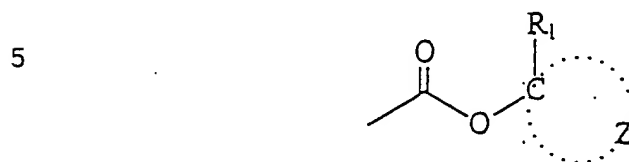
20 12. A resist composition as claimed in
claim 8, wherein said additional functional group
includes a monomer unit having an ester group, said
ester group including a polycyclic alicyclic
25 hydrocarbon part that causes a deprotection in
response to an acid produced by a photoacid generator.

30 13. A resist composition as claimed in
claim 12, wherein said polycyclic alicyclic
hydrocarbon part includes an adamantyl group or a
norbornyl group.

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1 14. A resist composition as claimed in
claim 11, wherein said additional carboxyl group
having a formula of:



wherein R_1 represents an alkyl group having a straight
10 chain or a branched chain including 1 - 4 carbon
atoms, said alkyl group being any of a substituted
group and an unsubstituted group, and wherein Z_1
represents a plurality of atoms necessary to complete
an alicyclic hydrocarbon group together with the
15 carbon atoms connected to R_1 .

20 15. A resist composition as claimed in
claim 8, wherein said resist composition has an
absorbance of 1.75 or less when provided on a silicon
oxide substrate in the form of a resist film.

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16. A resist composition as claimed in
claim 8, further comprising a solvent selected from a
30 group consisting of: ethyl lactate, methylamylketone,
methyl-3-methoxypropionate, ethyl-3-ethoxypropionate,
propyleneglycol methylether acetate, and a mixture
thereof.

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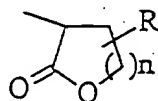
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1 17. A resist composition as claimed in
claim 16, further including a solvent selected from a
group consisting of butyl acetate, γ (gamma)-
butyrolactone and propyleneglycol methylether as an
5 auxiliary solvent.

10 18. A method of forming a resist pattern,
comprising the steps of:

 applying a resist composition on a substrate
to form a resist film, said resist composition
comprising:

15 an acid-sensitive polymer compound
insoluble to an alkaline solution, said acid-
sensitive polymer compound comprising a film-
forming polymer; a carboxyl group bonding to a
side chain of said polymer main chain, said
20 carboxyl group having a protective group; and an
additional acidic functional group bonding to a
side chain of said polymer main chain, said
acidic functional group having an acid-cleavable
protective group; said carboxyl group having, as
25 said protective group, a lactone structure
represented by a formula



30 wherein n is an integer of 1 - 4, and R
represents any of a hydrogen atom, an alkyl
group, an alkoxy group and an alkoxy carbonyl
group and bonding to an arbitrary position of
35 said lactone structure excluding a second
position forming an ester bonding; and
 a photoacid generator causing a

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1 decomposition in response to an absorption of a
radiation, said photoacid generator releasing an
acid that causes a deprotection of said acid-
cleavable protective group in response to said
5 decomposition;

said resist composition becoming
soluble to said alkaline solution after said
acid-cleavable protective group has caused said
deprotection;

10 exposing said resist film to an exposure
radiation that induces said decomposition in said
photoacid generator; and

developing said resist film, after said
process of exposing, by a basic solution.

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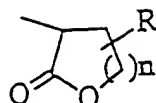
19. A method of forming a resist pattern,
20 comprising the steps of:

applying a resist composition on a substrate
to form a resist film, said resist composition
comprising:

25 an acid-sensitive polymer compound
insoluble to an alkaline solution, said acid-
sensitive polymer compound comprising a film-
forming polymer; a carboxyl group bonding to a
side chain of said polymer main chain, said
carboxyl group having a protective group; and an
30 additional acidic functional group bonding to a
side chain of said polymer main chain, said
acidic functional group having an acid-cleavable
protective group; said carboxyl group having, as
said protective group, a lactone structure
35 represented by a formula

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wherein n is an integer of 1 - 4, and R represents any of a hydrogen atom, an alkyl group, an alkoxy group or an alkoxycarbonyl group and connected to an arbitrary position of said lactone structure excluding a second position forming an ester bonding; and

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a photoacid generator causing a decomposition in response to an absorption of a radiation, said photoacid generator releasing an acid that causes a deprotection of said acid-cleavable protective group in response to said decomposition;

15

said resist composition becoming soluble to said alkaline solution after said acid-cleavable protective group has caused said deprotection;

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exposing said resist film to an exposure radiation that induces said decomposition in said photoacid generator;

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developing said resist film, after said step of exposure, by a basic solution to form a resist pattern; and

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etching said substrate while using said resist pattern as a mask.

20. A method as claimed in claim 19, wherein said step of forming said resist film includes a step of applying a solution of said resist composition on said substrate with a thickness of 0.1

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1 - 2 μm .

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21. A method as claimed in claim 19,
wherein said step of exposing said resist film is
conducted by a KrF excimer laser.

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22. A method as claimed in claim 19,
wherein said step of exposing said resist film is
15 conducted by an ArF excimer laser.

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23. A method as claimed in claim 19,
wherein said step of developing is conducted by using
an alkaline aqueous solution.

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